Use of LIDAR in Wetland Delineation on West Galveston Island, Texas

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March 2005

Light Detection and Ranging (LIDAR) is a remote sensing technique that uses a laser mounted to an aircraft to measure vertical height of a land surface (elevation). LIDAR is increasingly used in support of Geospatial Information Systems (GIS) applications. LIDAR can be used in any application that has to consider the elevation of a land surface. Uses of LIDAR include but are not limited to:

- Habitat classification -- forest cover, wetlands, shorelines,
- Floodplain delineation,
- Land subsidence mapping, and
- Land use classification.

The National Biological Information Infrastructure's (NBII) Central Southwest Gulf Coast Information Node (CSWGCIN) undertook a project to use LIDAR data and digital orthophotography to aid in the classification of wetlands in Galveston Bay, Texas.

Traditional wetland mapping techniques involve the photo interpretation of Color Infrared (CIR) or true color aerial photography or the classification of multispectral satellite images. These methods can be problematic in that they often exclude height information for the vegetation being mapped. Detailed structural characterization of intertidal marshes is particularly challenging because sites typically have a complex net of small channels with low elevation relief (Rosso et al., 2003). LIDAR provides valuable elevation information and in combination with the spectral data, will present better opportunities for a more accurate classification. In Levent et al. (2004), similarities existed in separate observations using ground surveying and LIDAR, used to detect vegetation height with eight classes identified: (1) Water, (2) Herb and Shrubs, (3) Low Plants, (4) Medium Height Plants, (5) Tall Plants, (6) Very Tall Plants, (7) Low Trees, and (8) Medium Trees.

LIDAR is an airborne laser measuring system which produces a data set of point elevations over large land areas. Many types of LIDAR systems exist. This project used data from TerraPoint™, LLC. TerraPoint's Airborne Laser Topographic Mapping System (ALTMS) is capable of recoding up to four returns from each laser pulse. Flights are conducted at an altitude of approximately 915 meters, yielding a point spacing of 1.7 meters. Each data record consists of the x coordinate in UTM 14, y coordinate in UTM 14, orthometric height in meters, return number, and feature classification. TerraPoint employs TerraScan by TerraSolid (TerraScan, 1999) to classify features as ground or error points. Each point record has a feature classification of ground, non-ground, or error; allowing for the creation of a bare ground Digital Terrain Model

(DTM). Several methods of DTM classification are available (Pfeifer et al., 1999), however the TerraScan method is well established and widely accepted.

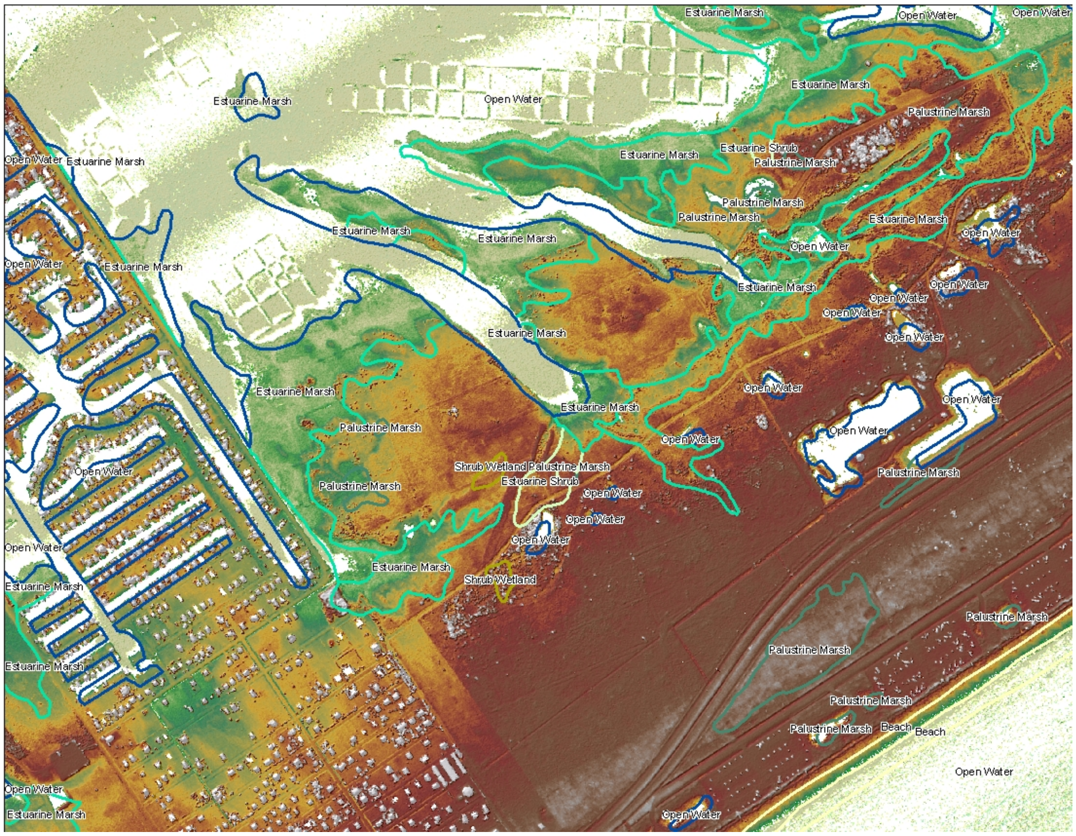
The Z valve of the LIDAR points represented a height above sea level. Height above ground, essential to development of a vegetation classification, was determined. A DTM surface was developed by creating a Triangulated Irregular Network (TIN) from the LIDAR points classified as ground. The TIN was then converted to a raster grid, providing a smoother surface through the elimination of areas of no data. For each LIDAR point, a ground Z value was derived by interpolation from the DTM. Height above ground was calculated by subtracting each point's ground Z value from its original Z value. A new raster surface was then created from the ground height values and classified into distinct groups using a texture filter based on the variety of height values within a moving window (MacKinnon, 2001).

Separately, Color Infrared (CIR) Orthophotos from the Texas Strategic Mapping Program were classified into vegetative and non-vegetative areas. Data were merged with the classified height values to produce a coverage of vegetative areas with height above ground. The data set provided a basis for determining different wetland species based upon unique combinations of spectral characteristics and height.

Several tests were conducted along Galveston Island using various height classifications and textures in known wetland areas. Areas were compared to wetland classifications from the National Wetland Inventory (NWI). As seen in the images below, a high correlation was observed between individual height classes and mapped wetland areas.

Figure 1. Overlay of NWI wetland classification onto a color infrared orthophoto of Galveston Island State Park on West Galveston Island, Texas.

Figure 2. Overlay of NWI wetland classification onto a LIDAR remotely sensed image of Galveston Island State Park on West Galveston Island, Texas.



Certain factors must be taken into account when classifying wetland habitat regardless of the type of remotely sensed data used. Seasonality has a great influence on wetland delineation data and interpretation. As an example, LIDAR data and aerial imagery flown and acquired in rainy seasons could provide an overestimation of wetland coverage, while data flown and collected in dry months could provide an underestimation. Care must also be exercised when interpreting coastal data where tidal cycles have a profound influence on the location of the shoreline. As with any classification exercise using remotely sensed data, ground-truthing (an in-the-field comparison) is essential for the production of a high quality, accurate product.

In conclusion, LIDAR data are very useful when used for wetland classification and delineation. The method described above provides accurate maps for ground truth field surveys and can aid researchers and resource managers in the development of wetland delineation maps.

References

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Visit projects using LIDAR

- CSWGCIN Black Capped Vireo Project
- BEG Texas Shoreline Change Project
- Harris County, Texas Floodplain Maps

Download LIDAR Data for the CSWGC Region:

- Arkansas Spatial Data Infrastructure
- Louisiana Atlas LIDAR Download
- National Map Seamless Data Distribution System
- NOAA Coastal Services Center LIDAR Download